UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P O Box 1450
Alexandria, Virginia 22313-1450
www uspto gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/821,390	04/09/2004	Mark S. Wallace	040319	1595

23696 7590 05/12/2010
QUALCOMM INCORPORATED
5775 MOREHOUSE DR.
SAN DIEGO, CA 92121

EXAMINER	
WONG, LINDA	

ART UNIT	PAPER NUMBER
2611	

NOTIFICATION DATE	DELIVERY MODE
05/12/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

us-docketing@qualcomm.com
kascanla@qualcomm.com
nanm@qualcomm.com

Office Action Summary	Application No.	Applicant(s)
	10/821,390	WALLACE ET AL.
	Examiner	Art Unit
	LINDA WONG	2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 April 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-55* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Response to Arguments

1. Applicant's arguments, see Applicant's Arguments, filed 4/01/2010, with respect to the rejection(s) of claim(s) 1-55 under Kishigami et al have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Kishigami et al in view of Adams (US Patent No.: 6218985).

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

2. **Claims 1-12,17-20,21-33,39-41,42-46,50-52** is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.
   a. **Claim 1** pertains to mathematical steps of "generating steering matrices" and is directed to a judicial exception to 35 U.S.C. 101 (i.e., an abstract idea, natural phenomenon, or law of nature) and is not directed to a practical application of such judicial exception (e.g., because the claim does not require any physical transformation and the invention as claimed does not produce a useful, concrete, and tangible result).
   b. **Claims 17,21,39,42,50** recites the steps and components of "generating steering matrices", wherein paragraph 75 states the steps and components can be performed in software. Software is directed towards a judicial exception to 35 USC 101 (i.e., an abstract idea, natural phenomenon, or law of nature) and

is not directed to a practical application of such judicial exception (e.g., because the claim does not require any physical transformation and the invention as claimed does not produce a useful, concrete, and tangible result).

c. **Claims 2-12,18-20,22-33,40-41,43-46,51-52** are rejected as per the respective independent claim.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. **Claims 13,34,47** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Such claims recite the term "operative", wherein the term does not concretely, positively and definitely performs the step or functionality as recited.

4. **Claims 14-16,35-38,48-49** are rejected based on the respective independent claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 1-3,5-6,10,15,17,19,21,24-25,29,32-33,35-36,40-42,45-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Adams (US Patent No.: 6218985).

   a. **Claims 1,17**,

      i. Kishigami et al discloses

         - "obtaining a base matrix" (Equation 12, label Qm as the base matrix)
         - "at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value" (Equation 12, label a(θ) as the scalar vector, wherein the scalar vector contains scalar values selected for a specific array antenna. (Col. 4, lines 50-51 discloses a(θ) is produced for the array antenna. Col. 14, line 15, equation 33 shows the elements in a(θ), wherein the values can be real or complex depending on θ. Based on the laws of multiplying matrices', the scalar vector as shown in Eq. 33 as a column, would be multiplied with each row of the matrix, Qm.) and
         - "forming at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars". (Equation 12 in Col. 6, line 26 discloses multiplying the base matrix, Qm, with steering vector or scalar a(θ), wherein b(θ) is a modified steering vector. Col. 19,

lines 9-15 discloses the Qm and a(θ) is a unitary transform of R, the correlation matrix or steering matrix.)

ii. Kishigami et al does not clearly show selecting at least different scalar values.

iii. Adams discloses in Col. 3, line14-40 discloses an active sector of the antenna array, wherein the active sector is antenna elements of the antenna array being driven. The beam pattern of the antenna array is determined by selecting M values of the azimuth angle. Kishigami et al discloses equation 33 as the steering vector for the antenna array shown in Fig. 1, wherein the steering vector values dependents on the azimuth angle. It would have been obvious to one skilled in the art to select the azimuth angle according to selecting M values to produce a beam pattern of the antenna array as disclosed by Adams in the calculation of the steering vector as disclosed by Kishigami et al so to produce the desired steered beam pattern, which contributes to effectively determining the angle of arrival as shown in Equation 4 of Kishigami et al. (The steering vector affects the calculation of the angle of arrival (F(θ))).

b. **Claim 2**, Kishigami et al discloses “forming a plurality of steering vectors with columns of the at least one steering matrix”. (Equation 12 discloses a modified steering matrix using a(θ), wherein a(θ) can be computed for multiple θ.)

c. **Claim 3**, Kishigami et al discloses "the base matrix is a unitary matrix having orthogonal columns." (Col. 6, line 25 discloses the base matrix is a unitary

matrix. Such a matrix is used to compute the steering vector b(θ), which can be used to produce R matrix. (Fig. 10 shows the correlation matrix R transformed in to a unitary equivalent using Qm, a(θ).) R matrix is the correlation matrix containing eigenvectors, such vectors are orthogonal, thus Qm would have orthogonal elements.)

d. **Claims 5,14,18,27,37**, Kishigami et al discloses the base matrix is a unitary matrix, wherein Walsh matrix is a type of unitary matrix. (Col. 6, line 25 discloses the base matrix is a unitary matrix.)

e. **Claims 6,15,19,29,** Kishigami et al discloses "each of the at least one steering matrix has orthogonal columns". (Equation 12 shows the equation for producing the unitary transform of matrix R, wherein matrix R is orthogonal, thus would have orthogonal columns. (Col. 19, lines 9-15 discloses the Qm and a(θ) is a unitary transform of R, the correlation matrix or steering matrix. Col. 1, lines 44-67 discloses R is orthogonal.)

f. **Claim 9,31**, Kishigami et al discloses "each of the at least one steering matrix includes elements having equal magnitude." (Equation 12 discloses the production of the vectors of the steering matrix R, wherein depending on the calculation of b(θ), R can have elements with equal magnitude.)

g. **Claim 10**, Kishigami et al discloses "the base matrix has a dimension of N by N, where N is an integer greater than one, and wherein each combination includes N - 1 scalars for N - 1 rows of the base matrix". (Col. 1, lines 44-45 disclose the correlation matrix is a MxM matrix. Line 25 indicates M > 1. Since the base

matrix is used to produce a unitary transformation of the correlation matrix, the base matrix would also have the same dimension as the correlation matrix. Equation 12 shows scalar multiplied with the base matrix, wherein the number of scalars and rows would depend on the number of elements in a row of the matrix and scalar vector.)

h. **Claim 21** inherits all the limitations of claim 1, but claim 1 fails to recite "processing data to obtain a block of data symbols to be transmitted in a plurality of transmission spans" and "performing spatial processing on at least one data symbol to be transmitted in each transmission span with the steering matrix obtained for the transmission span, the spatial processing resulting in the block of data symbols observing a plurality of effective channels formed with the plurality of steering matrices." (Fig. 18, labels 89-1-89-L shows the plurality of transmission, label 71 determines the block of data symbols to be transmitted. Col. 6, lines 11-16 disclose the correlation matrix is used for spatial smoothing. Fig. 18, label 63 determines the arrival direction using equation 12 and correlation matrix R, wherein the spatial processing or smoothing involves observing the channel. Regarding the limitation, plurality of transmission spans, Col. 1, lines 20-25 discloses the accuracy of a plurality of incident waves are estimated. Each incident wave would arrive at a different angle, wherein time would also be different.)

i. **Claim 24**, Kishigami et al discloses "the plurality of transmission spans correspond to a plurality of time intervals." (Col. 1, lines 20-25 discloses the

accuracy of a plurality of incident waves are estimated. Each incident wave would arrive at a different angle, wherein time would also be different.)

j. **Claims 25,35,40**, Kishigami et al discloses “each steering matrix has one column, and wherein one data symbol is transmitted in each transmission span.” (Fig. 18, labels 89-1-89-L shows the multiple antennas for receiving information at a transmission span. Col. 1, lines 45 shows the equation for correlation matrix R, wherein R can have 1 column.)

k. **Claims 26,36,41**, Kishigami et al discloses “each steering matrix has multiple columns, and wherein multiple data symbols are transmitted simultaneously in each transmission span”. (Fig. 18, labels 89-1-89-L shows the multiple antennas for receiving information at a transmission span. Col. 1, lines 45 shows the equation for correlation matrix R, wherein R can have more than 1 column.)

l. **Claims 32,33**, Kishigami et al discloses “the plurality of steering matrices’ are unknown to a receiving entity for the block of data symbols" and “known only to the transmitting entity." (Fig. 18 shows a transmitter, wherein the transmitter does not have a connection to a connecting receiver for sending the steering matrices' used to produce the data transmitted. Thus, the receiving entity would receive the data without knowing the steering matrices' used.)

m. **Claims 34,39** inherit all the limitations of claim 21.

6. **Claims 12,53-55** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Adams (US Patent No.: 6218985).

   a. **Claim 12**, Kishigami et al discloses “the at least one combination of scalars is obtained with a base-K counter having one digit for each of the at least one scalar in a combination, where K is the number of different possible scalars usable for each row of the base matrix”. (Col. 13, lines 15-20 discloses k is used to determine the k-th element.) Although Kishigami et al fails to disclose "a base-K counter", a base-K counter is found in software or hardware in order to keep track of the element being used so to not run past the total number of elements. It would have been obvious to one skilled in the art at the time of the invention to use a base-K counter so to keep track of the number of elements in the vector and prevent an out of bound error.

   b. **Claim 53** recites all the limitations of claim 1 but claim 1 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 1. A processor can have instructions or software for controlling the steps as discussed in claim 1. It would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) in view of Adams so to easily calculate complex equations and provide an accurate calculation.

c. **Claim 54** recites all the limitations of claim 21 but claim 21 fails to recite the limitation "code for". Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 21. A processor can have instructions or software for controlling the steps as discussed in claim 21. It would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) in view of Adams so to easily calculate complex equations and provide an accurate calculation.

d. **Claim 55** recites all the limitations of claim42 but claim 42 fails to recite the limitation "code for". Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 42. A processor can have instructions or software for controlling the steps as discussed in claim 42. It would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) in view of Adams so to easily calculate complex equations and provide an accurate calculation.

7. **Claims 4,28** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Adams as applied to claim 1 in view of Craw (NPL: "The Fourier Matrix").

a. **Claim 4,28**, Kishigami et al fails to disclose "the base matrix is a Fourier matrix." Kishigami et al discloses the base matrix can be any unitary matrix (Col. 6, line 25 discloses the base matrix is a unitary matrix.), wherein Fourier matrix is a type of unitary matrix. (See reference The Fourier Matrix.) Thus, it would have been obvious to one skilled in the art to use a Fourier matrix, since the base matrix must be any unitary matrix.

8. **Claims 11,13** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Adams (US Patent No.: 6218985).

a. **Claim 11**, Kishigami et al discloses a correlation matrix R, is a MxM matrix, wherein R is used to produce the modified steering vector (Eqn. 12). The size of the matrix depends on the number of antennas as shown in Fig. 18 (Col. 4, lines 5-10) and can be "a power of two". It would be obvious to one skilled in the art for N to be a power of two depends on the number of antennas as well as the inventors design choice.

b. **Claim 13** inherits all the limitations of claim 1, but claim 1 fails to recite the limitation "a memory operative to store the base matrix, or at least one steering matrix, or both the base matrix and the at least one steering matrix". Kishigami et al discloses a processor (Col. 1, lines 30-32), wherein memory is common in a processor. It would have been obvious to one skilled in the art at the time of the invention to incorporate a memory block to store the base matrix and/or

steering matrix within the processor as disclosed by Kishigami et al so to allow for easy access to the information.

9. **Claims 22-23** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Adams as applied to claim 21 in view of Khatri (US Patent No.: 7020490).

   a. **Claim 22,**

      i. Kishigami et al fails to disclose "the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands."

      ii. Khatri discloses such limitations. (Col. 4, lines 53-56) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams so to provide independent phase and amplitude to avoid co-channel interference.

   b. **Claim 23,**

      i. Kishigami et al fails to disclose "multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein each of the plurality of transmission spans corresponds to one or more subbands in one time interval."

      ii. Khatri discloses such limitations. (Col. 4, lines 53-56 discloses sending information using different sub-bands and different carrier frequencies,

wherein such sub-bands and carrier frequencies can be more than 1.) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams so to provide independent phase and amplitude to avoid co-channel interference.

10. **Claims 42,45-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Adams (US Patent No.: 6218985), further in view of Khayrallah et al (US Patent No.: 6711124).
    a. **Claim 42** inherits all the limitations of claim 1 or 21, but claim 1 fails to recite the limitations "deriving a plurality of spatial filter matrices based on a channel response estimate and a plurality of steering matrices", "obtaining, in the plurality of transmission spans, R sequences of received symbols via R receive antennas, where R is an integer one or greater" and "performing receiver spatial processing on the R sequences of received symbols with the plurality of spatial filter matrices to obtain detected symbols".
    b. Kishigami et al fails to disclose such limitations.
    c. Khayrallah et al discloses in Fig. 6 a receiver uses the channel estimate for equalization, wherein the channel estimates are produced based on the training sequences. (Col. 1, lines 29-42) The training sequences are produced using the scaling matrix as shown in Fig. 3. Fig. 4 shows a plurality of antennas, wherein the plurality of antennas would receive one or more sequences since each

antenna would receive information. It would have been obvious to one skilled in the art at the time of the invention to incorporate the use of a channel equalizer as disclosed by Khayrallah et al into Kishigami et al in view of Adams so to eliminate interference within the signal after transmission by filter or equalizing.

d. **Claims 45 and 46**, Khayrallah et al discloses "each steering matrix has one column, and wherein each spatial filter matrix has a dimension of one by one" and "each steering matrix has N columns and each spatial filter matrix has a dimension of N by R, where N and R are integers greater than 2. (Fig. 6 shows the receiver performing channel estimation and equalization. Fig. 7 shows the calculation of the channel estimation. Col. 7, line 58-Col.8, line 18 discloses the channel estimates are determined based on the scaling value matrix elements from the column corresponding to the antenna. Given the scaling value matrix is one by one, then the channel estimates would be a one by one matrix. Given the scaling value matrix is N by R, wherein N and R are integers greater than 2, the channel estimate would be a N x R matrix.)

e. **Claims 47 and 50** inherits all the limitations of claim 42.

f. **Claims 48-49 and 51-52** inherits all the limitations of claims 45 and 46.

11. **Claims 43-44** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Adams, further in view of Khayrallah et al as applied to claim 42 in view of Khatri (US Patent No.: 7020490).

a. **Claim 43,**

i. Kishigami et al, and Adams fails to disclose "the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands."

ii. Khatri discloses such limitations. (Col. 4, lines 53-56) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams, further in view of Khayrallah so to provide independent phase and amplitude to avoid co-channel interference.

b. **Claim 44,**

i. Kishigami et al, and Adams fails to disclose "multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein each of the plurality of transmission spans corresponds to one or more subbands in one time interval."

ii. Khatri discloses such limitations. (Col. 4, lines 53-56 discloses sending information using different sub-bands and different carrier frequencies, wherein such sub-bands and carrier frequencies can be more than 1.) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams, further

in view of Khayrallah so to provide independent phase and amplitude to avoid co-channel interference.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LINDA WONG whose telephone number is (571)272-6044. The examiner can normally be reached on 9-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Payne can be reached on (571) 272-3024. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Linda Wong
5/5/2010

/David C. Payne/
Supervisory Patent Examiner, Art Unit 2611